BEST AVAILABLE COPY

(12) UK Patent Application (19) GB (11) 2 205 615 (13) A

(43) Application published 14 Dec 1988

(21) Application No 8713315

(22) Date of filing 6 Jun 1987

(71) Applicant
Salford University Civil Engineering Limited

(Incorporated in United Kingdom)

Telford Building, Meadow Road, Salford, M7 9PN

(72) Inventor
David Bassett

(74) Agent and/or Address for Service
Marks & Clerk
Suite 301, Sunlight House, Quay Street,
Manchester, M3 3JY

(51) INT CL⁴
F03B 7/00 F03C 2/30

(52) Domestic classification (Edition J):
F1S 30
F1F 1A3 1A4D 2N3 D EV
F1T H1E1

(56) Documents cited
GB 1561432 GB 1443674 GB 1366607
GB 1254777 EP A1 0008590

(58) Field of search
F1F
F1S
F1T
Selected US specifications from IPC sub-class F03B

(54) A water powered motor

(57) The motor has a casing 6 defining a passageway extending between inlet 11 and outlet 12 apertures, and a rotor 1 mounted to rotate within the passageway about a fixed axis. The radial distance between the rotor axis and adjacent walls of the passageway is greater on one side of the rotor axis than the other, and a plurality of vanes 9 are movably mounted on the rotor. The vanes assume a position relative to the rotor such that the passageway is always obstructed by the vanes and rotor which extend across the full width of the passageway between the adjacent walls. As the rotor is offset towards one side of the passageway, and therefore the surface area presented by the vanes to water flowing from the inlet to the outlet is greater on one side of the rotor than the other, a torque is applied to the rotor. In an alternative arrangement the vanes are instead pivoted to the rotor and are arcuate (Figs. 7 to 10).

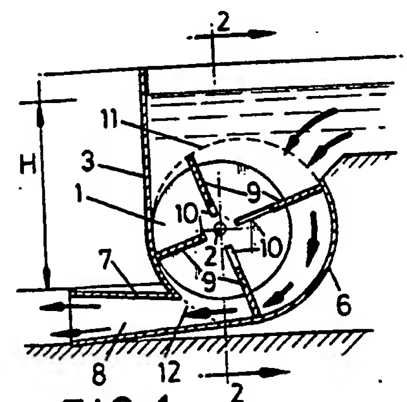

FIG.1

The drawing(s) originally filed was (were) informal and the print here reproduced is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

GB 2 205 615 A

2205615

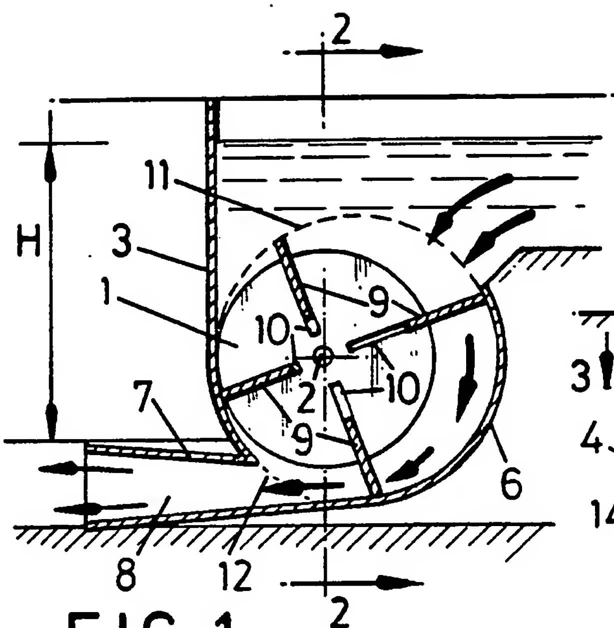

FIG.1

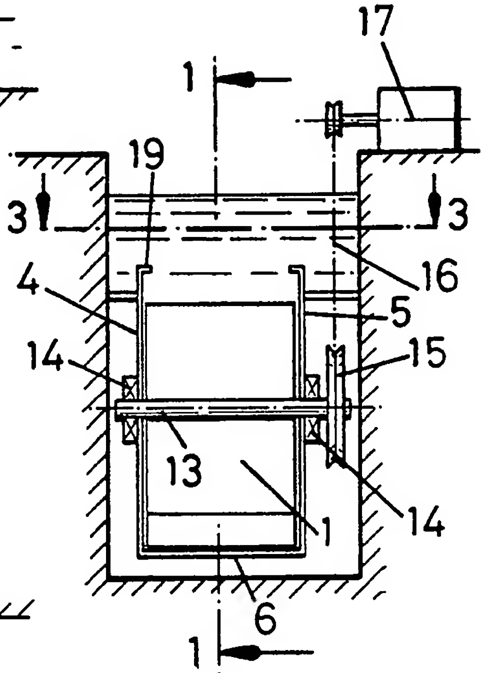

FIG.2

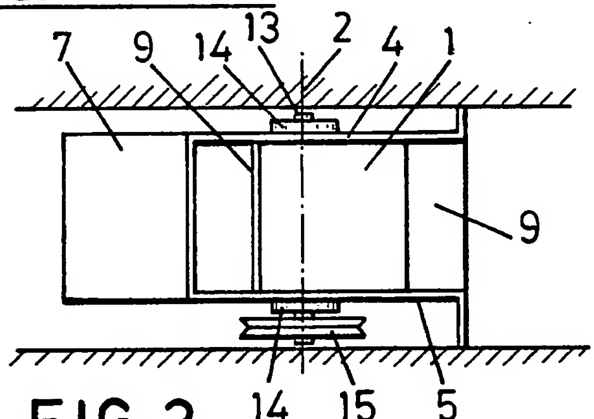

FIG.3

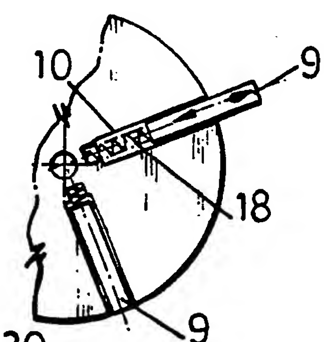

FIG.4

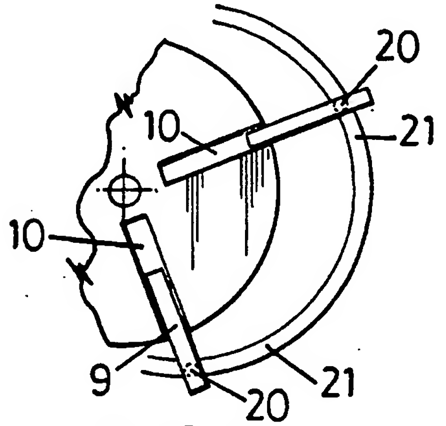

FIG.5

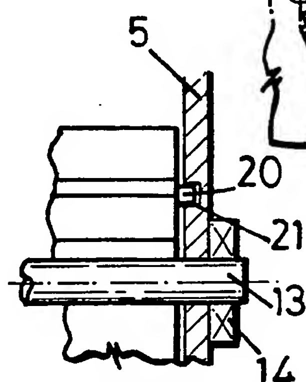

FIG.6

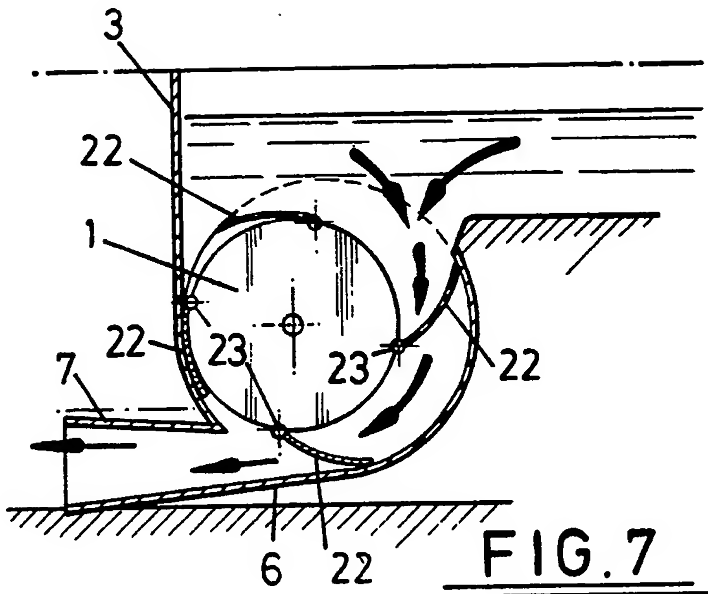

FIG.7

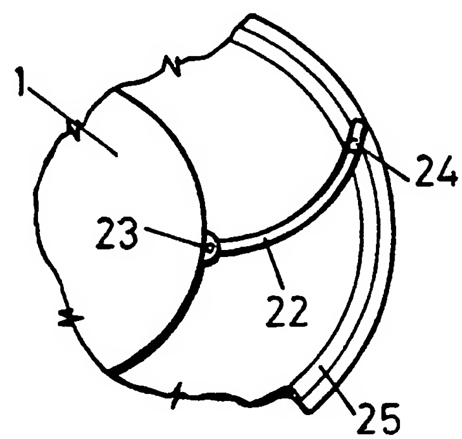

FIG 8

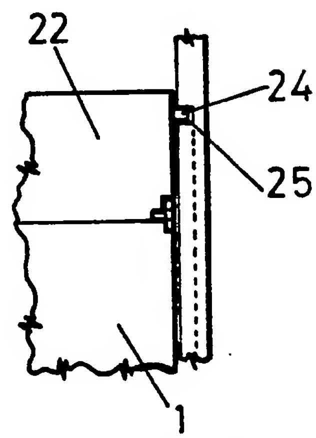

FIG.9

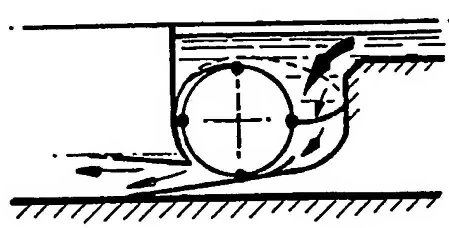

FIG.10

WATER POWERED MOTOR

2205615

The present invention relates to a water powered motor.

Man has obtained power from water for centuries, the use of water power reaching a high point during the nineteenth century. Various devices were developed to extract power from the potential and kinetic energy of water. Water wheels with diameters of five metres or more were developed for use in situations where an equivalent head of water was available but in due course the water wheels were replaced by reaction turbines such as Francis or propellor-type turbines or impulse turbines such as Pelton wheel turbines driven by high velocity jets of water. The advantage of the turbines was that relatively small devices could be used to extract power from a large head of water.

In due course the water turbines were themselves superseded by other prime movers such as diesel engines except in circumstances where very high water heads are available. In developed countries hydro-electric systems have been installed in most if not all suitable locations and even in undeveloped countries most of the major available sites have large scale systems installed.

There are many circumstances worldwide in both developed and undeveloped countries where there are plentiful supplies of flowing water available of limited head and a demand for electric power. In developed countries the power demand is supplied by for example diesel generators. In undeveloped countries the resources are not available for the purchase, maintenance and fuelling of electrical generators and the demand for power is unsatisfied. Some power could be generated using conventional water wheels incorporating a wheel supporting fixed

buckets but because of the limited head available the power which could be generated is very limited. Furthermore, because the available head is so small high velocity water jets of the type required by water turbines cannot be produced.

Hydraulic vane motors are known in which a rotor with several spring-loaded sliding vanes is mounted in an elliptical chamber. Hydraulic fluid is pumped into the chamber via an inlet and forces the vanes before it as it moves to the outlet. Because the chamber is elliptical, torque is applied to the rotor on the side thereof which is furthest from the chamber wall, the sliding vanes taking up variations in the radial distance between the rotor and the chamber wall. Vane motors of this type enable the production of low speed high torque devices, relying upon the high pressure of the hydraulic fluid to develop the required torque. Vane motors are also known which are driven by high pressure air, the rotor and vane structure being similar to that of hydraulic vane motors but generally relying upon the rapid angular rotation of the rotor to throw the vanes outwards into contact with the chamber wall. The air driven vane motors produce a high speed output, the output torque being a function of the available air pressure.

It is an object of the present invention to provide a water powered motor which is capable of efficiently extracting power from a low pressure water supply.

According to the present invention there is provided a water powered motor comprising a casing defining a passageway extending between inlet and outlet apertures, a rotor mounted to rotate within the passageway about a fixed axis, the radial

distance between the rotor axis and adjacent walls of the passageway being greater on one side of the rotor axis than the other, a plurality of vanes movably mounted on the rotor, and means for controlling the position of each vane relative to the rotor in dependence upon the angular position of the rotor such that the passageway is obstructed by the vanes and rotor which extend across the full width of the passageway between the said adjacent walls.

The rotor is offset towards one side of the passageway, and therefore the surface area presented by the vanes to water flowing from the inlet to the outlet is greater on one side of the rotor than the other. As a result a torque is applied to the rotor.

In contrast to prior art water powered motors of the type normally referred to as water wheels the movable vanes are in effect only extended when required and do not result in churning of either the head or tail waters except to a relatively limited extent. It is therefore not necessary to precisely position the top of the rotor relative to the head waters nor to lift the bottom of the rotor clear of the tail waters. This means that a useful amount of power can be developed even from very limited heads of water.

The water powered motor of the present invention can be manufactured in the form of a box of robust form ready for mounting in a simple cutting between for example upper and lower levels of a crop irrigation scheme. Little expertise is therefore required to install the motor. The motor components are also of extreme simplicity and require minimal maintenance.

In contrast to the known vane motors the water powered motor of the present invention is of

relatively large scale and is used in circumstances of low pressure and low speed. Although there are clear similarities in structure between the motor of the present invention and the known prior art vane motors there are major differences in scale and field of application which clearly distinguish the present invention from the prior art vane motors.

The rotor axis may be horizontal or vertical. The rotor will generally be supported on a shaft which extends through the casing and supports on its end for example a pulley. The pulley can be connected by a simple belt to for example a simple electrical generator.

The vanes may be substantially planar and supported in slots defined by a drum-like rotor. The radial position of the vanes may be controlled in any suitable manner, for example by biassing the vanes outwards using compression springs or by supporting rollers on the radial ends of the vanes, the rollers running in grooves. Alternatively the vanes may be pivotally supported on a drum-like rotor, the vanes preferably being of arcuate shape so as to be capable of folding down close to the surface of the drum. The arcuate vanes may be spring-loaded outwards or may support rollers running in grooves in the casing.

The grooves may be circular for ease of manufacture but preferably are of a more complex shape, for example elliptical, so as to limit the vanes extent when they cannot contribute to the power output of the device. Limiting the vanes extents reduces power losses due to churning of the supply water.

The casing may define an outlet chute through which the supply water is discharged to again minimize churning of tail waters by the rotor vanes.

The casing may also define an overflow such that in the event of the supply waters exceeding the motor capacity the supply waters can be discharged without causing problems.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which :

Fig. 1 is a side sectional view of a first embodiment of the present invention;

Fig. 2 is a section on the line 2-2 of Fig.1, Fig. 1 being a section on the line 1-1 of Fig. 2;

Fig. 3 is a plan view of the embodiment of Figs. 1 and 2;

Fig. 4 is a schematic illustration of one means for controlling the position of the vanes of the embodiment of Figs. 1 to 3;

Figs. 5 and 6 are schematic illustrations of another arrangement for controlling the positions of the vanes of the embodiment of Figs. 1 to 3;

Fig. 7 is a side sectional view of another embodiment of the present invention;

Figs. 8 and 9 illustrate one arrangement for controlling the position of the vanes of the embodiment of Fig. 7; and

Fig. 10 is a schematic illustration of a modification to the vane control arrangement illustrated in Figs. 8 and 9.

Referring to Figs. 1 to 3 of the accompanying drawings, the illustrated water powered motor comprises a rotor 1 which is mounted for rotation about an axis 2 in a casing comprising front wall 3, side walls 4 and 5, and a rear and underside wall 6. A bottom portion of the wall 6 defines with a wall 7 extending from the bottom of the wall 3 a draught tube 8. The rotor 1 supports four vanes 9

which are supported in radial slots 10 defined in the rotor.

The casing defines an inlet between wall 3 and the uppermost portion of wall 6 and an outlet defined by the draught tube 8 between which is a passageway. The rotor 1 is located to one side of the passageway so that the radial distance between the axis 2 and the walls 3 and 6 of the casing is large on the side of the rotor facing the wall 6 and substantially zero on the side of the rotor facing the wall 3. The vanes 9 are slidable within the slots 10 as described in more detail hereinbelow such that the radially outer edges of the vanes describe a circular path indicated by dotted lines 11 and 12 and by the walls 3 and 6 between the dotted lines 11 and 12.

As best shown in Fig. 2, the rotor 1 is supported on a shaft 13 mounted in simple bearings 14, the shaft 13 supporting a pulley 15. The pulley is linked by a belt indicated schematically by dotted line 16 to the shaft of an electrical generator 17 which is mounted above ground level.

Because the axis of the rotor 1 is to one side of the passageway described between the inlet and outlet of the illustrated arrangement when water is supplied to the inlet as shown in Fig. 1 a differential pressure is applied to the vane or vanes obstructing the passageway between the rotor 1 and the wall 6. This applies a torque to the rotor shaft which accordingly rotates. This torque is applied to the generator 17 which produces an electrical output in a conventional manner. As the distance to which the vanes 9 project from the body of the rotor 1 is relatively small except in the area defined between the rotor 1 and the wall 6 they do not result in a large churning effect which would absorb energy

obtainable from the head of water the extent of which is indicated by dimension H in Fig. 1. Also as the draught tube 8 extends beyond the maximum extent of the vanes 9 beneath the rotor the fact that the water level downstream of the illustrated motor is higher than the bottom of the draught tube 8 does not result in excessive churning. Accordingly the illustrated arrangement is of high efficiency and can be used to derive relatively large amounts of energy from a small head of water, for example of two metres.

The illustrated unit can be delivered in the form of a simple container ready for installation in a simple cutting provided between different levels in an irrigation system for example. Only the most basic building techniques are required for the installation of the equipment and maintenance requirements are minimal. Accordingly the illustrated arrangement can be used in circumstances where capital expenditure or expenditure on maintenance technicians must be severely limited.

Fig. 4 illustrates one arrangement for ensuring that the vanes 9 of the arrangement of Figs. 1 to 3 assume the appropriate radial position. As shown in Fig. 4 the vanes 9 are biassed radially outwards by springs 18. The peripheral edge of each vane runs either against the wall 6 or the wall 3 or against an appropriate lip 19 (Fig. 2) which follows the lines 11 and 12 of Fig. 1. Given that the natural tendency of the vanes 9 when the rotor rotates is to move radially outwards a relatively small spring force is sufficient to provide the required movement of the vanes 9.

Figs. 5 and 6 illustrate alternative arrangements for ensuring that the vanes 9 assume the appropriate radial position. In the arrangement of

Figs. 5 and 6 each vane supports on each of its side a peg or roller 20 which runs in a groove 21 defined in the adjacent side wall 4 or 5.

Referring now to Fig. 7 an arrangement is illustrated which differs from that of Figs. 1 to 3 in that rather than having radially slidable vanes 9 the arrangement comprises pivotal vanes 22 which are pivotal about pivot axes 23. In other respects the embodiments of Figs. 1 to 3 and Fig. 7 are essentially the same and accordingly the same reference numerals are used for equivalent components.

Figs. 8 and 9 illustrate arrangements for ensuring the appropriate radial positioning of the vanes 22, each vane again supporting pegs or rollers 24 running in grooves 25.

Fig. 10 illustrates an arrangement similar to that of Fig. 7 except for the fact that the radially outer ends of the vanes 22 describe an elliptical path rather than a circular path. This limits the radial extent of the vanes except in those portions of the system where the vanes can contribute to the power output of the device. This reduces the churning effects before the vanes are in a useful position still further. More complex extension paths than a simple ellipse could also be provided to further limit churning effects.

The individual vanes could be provided with appropriate formations to provide a one-way valve effect so that churning effects are further limited, the one-way valves only being closed when the pressure across the vanes is such as to assist rotation of the rotor 1 in the normal drive direction of the illustrated motor.

It will be appreciated from Figs. 1 and 7 that the top edge of the wall 3 provides a simple overflow

edge such that if the water flowing towards the motor exceeds that which can be passed through the motor the excess will simply flow over the device without causing damage.

It will be noted that in the illustrated embodiments the rotor and vanes are in normal circumstances fully submerged at all times. This will normally be the case but is not necessarily so, depending on the particular conditions in which the motor is to be used and the water flow rate at any particular time.

CLAIMS:

1. A water powered motor comprising a casing defining a passageway extending between inlet and outlet apertures, a rotor mounted to rotate within the passageway about a fixed axis, the radial distance between the rotor axis and adjacent walls of the passageway being greater on one side of the rotor axis than the other, a plurality of vanes movably mounted on the rotor, and means for controlling the position of each vane relative to the rotor in dependence upon the angular position of the rotor such that the passageway is obstructed by the vanes and rotor which extend across the full width of the passageway between the said adjacent walls.

2. A water powered motor according to claim 1, wherein the rotor axis is horizontal.

3. A water powered motor according to claim 1, wherein the rotor axis is vertical.

4. A water powered motor according to any preceding claim, wherein the rotor is supported on a shaft which extends through the casing.

5. A water powered motor according to claim 4, wherein a pulley is mounted on an end of the shaft, the pulley being connected by a simple belt to an electrical generator.

6. A water powered motor according to any preceding claim, wherein the vanes are substantially planar and supported in slots defined by a drum-like rotor.

7. A water powered motor according to claim 6, wherein the vanes are biased radially outwards by compression springs.

8. A water powered motor according to claim 6, wherein rollers are supported on the radial ends of

the vanes, the rollers running in grooves defined by the casing.

9. A water powered motor according to any one of claims 1 to 5, wherein the vanes are pivotally supported on a drum-like rotor.

10. A water powered motor according to claim 9, wherein the vanes are of arcuate shape so as to be capable of folding down close to the surface of the drum.

11. A water powered motor according to claim 9 or 10, wherein the arcuate vanes are spring-loaded outwards.

12. A water powered motor according to claim 9 or 10, wherein the arcuate vanes support rollers running in grooves in the casing.

13. A water powered motor according to claim 8 or 11, wherein the grooves are circular.

14. A water powered motor according to claim 8 or 11, wherein the grooves are elliptical.

15. A water powered motor according to any preceding claim, wherein the casing defines an outlet chute through which the supply water is discharged.

16. A water powered motor according to any preceding claim, wherein the casing defines an overflow such that in the event of the supply waters exceeding the motor capacity the supply waters are discharged via the overflow.

17. A water powered motor substantially as hereinbefore described with reference to the accompanying drawings.

Published 1988 at The Patent Office, State House, 66 71 High Holborn, London WC1R 4TP. Further copies may be obtained from The Patent Office, Sales Branch, St Mary Cray, Orpington, Kent BR5 3RD. Printed by Multiplex techniques ltd, St Mary Cray, Kent. Con. 1 87.